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MEMORANDUM

Introduction

This document contains the comments requested from [redacted] 25X1
[redacted] concerning 25X1
the A&A Report No. 285 entitled, "An Analysis and Appraisal of the [redacted] 25X1
[redacted] Ceramic Resonator and Crystal Filter IF Amplifiers." The report 25X1
was written in connection with Project No. 2004-181 and is dated 16 September 1960. Due to the interdependence of various measurements and operating conditions, the comments below are organized in the following manner. The sequence used is in accordance with the page numbering of the subject Report. Each comment is then given an Item Number which is subsequently used for cross referencing purposes throughout this memorandum. The Ceramic Resonator IF Amplifier is discussed first, followed by the Crystal Filter IF Amplifier.

Ceramic Resonator IF Amplifier

Page 4. Under "3.1.2 Mechanical Inspection" it is stated

Item 1 that the amplifiers are housed in "fragile thin wall copper cases." It is important to recall that these amplifiers were not intended for use as separate pieces of equipment but were designed for incorporation, with other circuitry, into an outer receiver case.

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Page 6 Item 2 The block diagram shown under "3.3.2 Output Impedances" indicates the use of a GR1432A Resistance Decade Box and a HP400DVTVM at the output of the amplifier. The GR1432A adds 30 to 45µµF while the HP400D with 2 feet of, for example, RG58 coaxial cable adds a further 85µµF. The resultant load would be highly capacitive (130µµF approx.). The amplifier was designed for use with a resistive load.

Page 8 Item 3 The Test-Setup with which the over-all gain was measured shows the use of a HP400DVTVM. This instrument, in conjunction with 2 feet of coaxial cable, will place 85µµF across the output. This will cause severe distortion of the pass band. See also the Spurious Response data and the Selectivity measurements. The apparent gain falls as the input level is increased due to increasingly severe clipping. This should be expected in an amplifier operating at minimum power drain without the benefit of AGC. Although AGC was to have been included in the design, as described in the Proposal, it was omitted in the actual design with concurrence of the Technical Representative.

Page 11&12 Item 4 The block diagram showing the test set up for measurement of Image and IF Rejection and Spurious Responses indicates that the input to the amplifier under test was fed from a 10 or 50 ohm source, depending on the output termination of the GR1001A Signal Generator. The correct source

impedance is 400 ohms. This mismatch will affect the selectivity curves as well as the spurious responses.

Carrier distortion of the GR type 1001A Signal Generator is listed as "on the order of 7%" by its manufacturer. Its output can be expected to contain appreciable amounts of 2nd, 3rd and 4th harmonic. Increasing the output level of the signal generator will result in a considerable percentage of harmonics being introduced into the amplifier under test. This is indicated by the spurious responses measured at 569.9 kc., 759.9 kc. and 1139 kc. The 4th harmonic of 569.9 kc. is 2.28 mc., the 3rd harmonic of 759.9 kc. is 2.28 mc. while the 2nd harmonic of 1139 kc. is 2.28 mc. The high input levels necessary to produce the remaining spurious responses shown on Page 12 could lead to a combination of amplifier saturation and direct feed through of the signal due to the very close physical spacing of the various stages.

The image rejection was originally measured with a constant input level at 2.28 mc. and 3.19 mc., under matched input and output conditions. The combined effect of overloading and mismatch resulting from the method described in the report probably accounts for the different in Image Rejection data.

Page 13 Item 5 — The test set up used for measurement of selectivity, as shown under 3.3.6 would lead to very heavy capacitive loading. Specifically:

H.P.524B counter:	40µµF + lead capacitance
HP400DVTVM:	25µµf + lead capacitance
515A Scope:	12 to 36µµF + lead capacitance (if probe is not used)

Under this type of capacitive load considerable alteration of the bandpass characteristics must be expected.

Crystal Filter Amplifier

Page 3 In the Report, the "Contractor's Final Test Data" concerning gain variation with temperature appears to have been misquoted. Reference to page 7 of the Sixth and Final Bimonthly Report will show that the gain variation at +40°C was reported as +1.5 db and at -40°C as -10 db. Consequently there is closer agreement between the Final Test Data and the R&D Laboratory Measurements than is indicated in the Report.

Page 6 See Item 2.

Page 8 See Item 3.

Page 10 It would appear that the wide discrepancy between the Final Test Data and the R&D Laboratory Measurement of gain can only be attributed to the development of a fault subsequent to delivery. It would be of interest to know whether the gain measurement was made after the amplifier was partially disassembled. A fault causing such a reduction in gain would

doubtless, cause considerable changes in other performance characteristics.

Page 11 See Item 4. In summary, spurious responses can be attributed to one or more of the following:

(i) Overloading the input by the high generator output level.

(ii) Heavy capacitive loading of the output stage due to the metering technique used.

(iii) The use of poor signal generator with high harmonic content. (7% according to its manufacture)

Page 12 The first six spurious responses occur at signal levels from 1.6 mv to 4.8 mv where the amplifier will overload. The following six responses occur in pairs corresponding to the peaks at either side of the pass band. The first pair coincide with the 4th harmonic present in the signal generator output. The second pair coincide with the 3rd harmonic while the last pair represent the 2nd harmonic content of the generator output.

Page 13 See Item 5.

Abstract It is stated that the Crystal Filter IF Amplifier did not meet the target specification with regard to its output frequency. This observation can probably be attributed to the list of specifications on Page 2 of the Proposal. This is, admittedly, confusing and, as has only now become apparent, suffers from a typographical error. The output frequency is

quoted as 445 kc. It was, of course, intended to read 455 kc. for the ceramic resonator amplifier. The output frequency of the Crystal Filter Amplifier was always intended to be the same as its input frequency since the purpose of this approach, as described in the Proposal, was to eliminate the need for a second converter stage in a superheterodyne receiver. In summary the following factors appear to be responsible for the various performance discrepancies.

1. Due to the absence of AGC and the minimum power consumption design of the amplifiers any measurement technique used must not be allowed to cause overloading.

2. The amplifiers were designed to operate between essentially resistive terminations. Measurement procedures cannot be allowed to place a large amount of capacitance across the terminations.

3. Spurious response measurements must be made with a signal generator having an absolute minimum of harmonic content in its output.

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[redacted]

Contract RD-107, T.O. 12

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Miniature IF Amplifiers

The evaluation of the two miniature IF amplifiers developed by [redacted] 25X1
[redacted] has been completed, and the results indicate performance below that 25X1
specified as design goals in the contractor's proposal. A copy of this report is being submitted to [redacted] for his comments. This contract was re- 25X1
quested to be terminated by August 1960.

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